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SELECTIVE REFLECTION IN THE INFRA-RED SPECTRUM.

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By

JAMES TEMPLE PORTER.

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DISSERTATION

SUBMITTED TO THE BOARD OF UNIVERSITY STUDIES  
OF THE JOHNS HOPKINS UNIVERSITY  
IN CONFORMITY WITH THE REQUIREMENTS FOR THE  
DEGREE OF DOCTOR OF PHILOSOPHY.

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BALTIMORE

1905.

СИМВОЛЫ МАСТЕРСКОГО РАБОТЫ ВЫПУСКАЮТСЯ

78

12.2.629

РУССКИЙ ЯЗЫК

СИМВОЛЫ

МАСТЕРСКОГО РАБОТЫ ВЫПУСКАЮТСЯ  
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СИМВОЛЫ

• СОЛЛ

## SELECTIVE REFLECTION IN THE INFRA-RED SPECTRUM.

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Certain substances which transmit a large percentage of the incident radiation in the visible portion of the spectrum, reflect strongly in the infra-red. Of these, one of the most noteworthy is quartz. It has been shown by Professor E. F. Nichols\* that in the neighborhood of wavelength  $8.5\mu$  the reflection from a quartz surface is 20 or 30 times greater than in the other parts of the spectrum, and that, consequently, in the spectrum of rays after three successive reflections these waves will lose little in intensity, whereas, those lying on either side of this value will be reduced in the ratio of (20) or (30)<sup>3</sup> to 1. The spectrum, then, after three reflections will contain practically only the radiation of wavelength  $\lambda = 8.5\mu$ , and this in measurable quantity. Rubens and Nichols\*\*, and Rubens and Aschkinass\*\*\* have employed

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\* E. F. Nichols, Physical Review, Vol. IV, p.297,(1897).  
\*\* Rubens and Nichols, Annalen, 60, pp.418 and 430 (1897).  
\*\*\* Rubens and Aschkinass, Annalen, 65, p. 241, (1898).

## LETTERS

containing water a fibrous white amorphous material and the resulting activity and reactivity probably are to result in complete loss of primary hydroxyl groups from the polymer and the activity at hydroxyl groups will be due to dehydroxylation and no direct attack of the cellulose by the acidic cation or methanesulfonate ion. The mechanism can be stated more fully as follows: (a) the cellulose is converted to a polyacid, (b) the polyacid is converted to a polyether, (c) the polyether is converted to a polyketone, (d) the polyketone is converted to a polyimide, (e) the polyimide is converted to a polyether, (f) the polyether is converted to a polyacid, (g) the polyacid is converted to a cellulose.

(a) To obtain the cellulose polyacid the cellulose is converted to a polyacid by treatment with concentrated sulfuric acid, and the reaction will be of the type:

$$\text{C}_6\text{H}_{10}\text{O}_5 + \text{H}_2\text{SO}_4 \rightarrow (\text{C}_6\text{H}_{10}\text{O}_5)_n + \text{H}_2\text{O}$$

(b) To obtain the cellulose polyether the cellulose polyacid is converted to a polyether by treatment with concentrated sulfuric acid, and the reaction will be of the type:

$$(\text{C}_6\text{H}_{10}\text{O}_5)_n + \text{H}_2\text{O} \rightarrow (\text{C}_6\text{H}_{10}\text{O}_5)_m + (\text{C}_6\text{H}_{10}\text{O}_5)_n$$

(c) To obtain the cellulose polyketone the cellulose polyether is converted to a polyketone by treatment with concentrated sulfuric acid, and the reaction will be of the type:

$$(\text{C}_6\text{H}_{10}\text{O}_5)_m + \text{H}_2\text{O} \rightarrow (\text{C}_6\text{H}_{10}\text{O}_5)_n + (\text{C}_6\text{H}_{10}\text{O}_5)_m$$

(d) To obtain the cellulose polyimide the cellulose polyketone is converted to a polyimide by treatment with concentrated sulfuric acid, and the reaction will be of the type:

$$(\text{C}_6\text{H}_{10}\text{O}_5)_n + \text{H}_2\text{O} \rightarrow (\text{C}_6\text{H}_{10}\text{O}_5)_m + (\text{C}_6\text{H}_{10}\text{O}_5)_n$$

- (1961) 7, 71-73; (1962) 7, 107-109; (1963) 7, 111-113; (1964) 7, 115-117; (1965) 7, 119-121; (1966) 7, 123-125; (1967) 7, 127-129; (1968) 7, 131-133; (1969) 7, 135-137; (1970) 7, 139-141; (1971) 7, 143-145; (1972) 7, 147-149; (1973) 7, 151-153; (1974) 7, 155-157; (1975) 7, 159-161; (1976) 7, 163-165; (1977) 7, 167-169; (1978) 7, 171-173; (1979) 7, 175-177; (1980) 7, 179-181; (1981) 7, 183-185; (1982) 7, 187-189; (1983) 7, 191-193; (1984) 7, 195-197; (1985) 7, 199-201; (1986) 7, 203-205; (1987) 7, 207-209; (1988) 7, 211-213; (1989) 7, 215-217; (1990) 7, 219-221; (1991) 7, 223-225; (1992) 7, 227-229; (1993) 7, 231-233; (1994) 7, 235-237; (1995) 7, 239-241; (1996) 7, 243-245; (1997) 7, 247-249; (1998) 7, 251-253; (1999) 7, 255-257; (2000) 7, 259-261; (2001) 7, 263-265; (2002) 7, 267-269; (2003) 7, 271-273; (2004) 7, 275-277; (2005) 7, 279-281; (2006) 7, 283-285; (2007) 7, 287-289; (2008) 7, 291-293; (2009) 7, 295-297; (2010) 7, 299-301; (2011) 7, 303-305; (2012) 7, 307-309; (2013) 7, 311-313; (2014) 7, 315-317; (2015) 7, 319-321; (2016) 7, 323-325; (2017) 7, 327-329; (2018) 7, 331-333; (2019) 7, 335-337; (2020) 7, 339-341; (2021) 7, 343-345; (2022) 7, 347-349; (2023) 7, 351-353; (2024) 7, 355-357; (2025) 7, 359-361; (2026) 7, 363-365; (2027) 7, 367-369; (2028) 7, 371-373; (2029) 7, 375-377; (2030) 7, 379-381; (2031) 7, 383-385; (2032) 7, 387-389; (2033) 7, 391-393; (2034) 7, 395-397; (2035) 7, 399-401; (2036) 7, 403-405; (2037) 7, 407-409; (2038) 7, 411-413; (2039) 7, 415-417; (2040) 7, 419-421; (2041) 7, 423-425; (2042) 7, 427-429; (2043) 7, 431-433; (2044) 7, 435-437; (2045) 7, 439-441; (2046) 7, 443-445; (2047) 7, 447-449; (2048) 7, 451-453; (2049) 7, 455-457; (2050) 7, 459-461; (2051) 7, 463-465; (2052) 7, 467-469; (2053) 7, 471-473; (2054) 7, 475-477; (2055) 7, 479-481; (2056) 7, 483-485; (2057) 7, 487-489; (2058) 7, 491-493; (2059) 7, 495-497; (2060) 7, 499-501; (2061) 7, 503-505; (2062) 7, 507-509; (2063) 7, 511-513; (2064) 7, 515-517; (2065) 7, 519-521; (2066) 7, 523-525; 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(2120) 7, 739-741; (2121) 7, 743-745; (2122) 7, 747-749; (2123) 7, 751-753; (2124) 7, 755-757; (2125) 7, 759-761; (2126) 7, 763-765; (2127) 7, 767-769; (2128) 7, 771-773; (2129) 7, 775-777; (2130) 7, 779-781; (2131) 7, 783-785; (2132) 7, 787-789; (2133) 7, 791-793; (2134) 7, 795-797; (2135) 7, 799-801; (2136) 7, 803-805; (2137) 7, 807-809; (2138) 7, 811-813; (2139) 7, 815-817; (2140) 7, 819-821; (2141) 7, 823-825; (2142) 7, 827-829; (2143) 7, 831-833; (2144) 7, 835-837; (2145) 7, 839-841; (2146) 7, 843-845; (2147) 7, 847-849; (2148) 7, 851-853; (2149) 7, 855-857; (2150) 7, 859-861; (2151) 7, 863-865; (2152) 7, 867-869; (2153) 7, 871-873; (2154) 7, 875-877; (2155) 7, 879-881; (2156) 7, 883-885; (2157) 7, 887-889; (2158) 7, 891-893; (2159) 7, 895-897; (2160) 7, 899-901; (2161) 7, 903-905; (2162) 7, 907-909; (2163) 7, 911-913; (2164) 7, 915-917; (2165) 7, 919-921; (2166) 7, 923-925; (2167) 7, 927-929; (2168) 7, 931-933; (2169) 7, 935-937; (2170) 7, 939-941; (2171) 7, 943-945; (2172) 7, 947-949; 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(2366) 7, 1723-1725; (2367) 7, 1727-1729; (2368) 7, 1731-1733; (2369) 7, 1735-1737; (2370) 7, 1739-1741; (2371) 7, 1743-1745; (2372) 7, 1747-1749; (2373) 7, 1751-1753; (2374) 7, 1755-1757; (2375) 7, 1759-1761; (2376) 7, 1763-1765; (2377) 7, 1767-1769; (2378) 7, 1771-1773; (2379) 7, 1775-1777; (2380) 7, 1779-1781; (2381) 7, 1783-1785; (2382) 7, 1787-1789; (2383) 7, 1791-1793; (2384) 7, 1795-1797; (2385) 7, 1799-1801; (2386) 7, 1803-1805; (2387) 7, 1807-1809; (2388) 7, 1811-1813; (2389) 7, 1815-1817; (2390) 7, 1819-1821; (2391) 7, 1823-1825; (2392) 7, 1827-1829; (2393) 7, 1831-1833; (2394) 7, 1835-1837; (2395) 7, 1839-1841; (2396) 7, 1843-1845; (2397) 7, 1847-1849; (2398) 7, 1851-1853; (2399) 7, 1855-1857; (2400) 7, 1859-1861; (2401) 7, 1863-1865; (2402) 7, 1867-1869; (2403) 7, 1871-1873; (2404) 7, 1875-1877; (2405) 7, 1879-1881; (2406) 7, 1883-1885; (2407) 7, 1887-1889; (2408) 7, 1891-1893; (2409) 7, 1895-1897; (2410) 7, 1899-1901; (2411) 7, 1903-1905; (2412) 7, 1907-1909; (2413) 7, 1911-1913; 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(2510) 7, 2299-2301; (2511) 7, 2303-2305; (2512) 7, 2307-2309; (2513) 7, 2311-2313; (2514) 7, 2315-2317; (2515) 7, 2319-2321; (2516) 7, 2323-2325; (2517) 7, 2327-2329; (2518) 7, 2331-2333; (2519) 7, 2335-2337; (2520) 7, 2339-2341; (2521) 7, 2343-2345; (2522) 7, 2347-2349; (2523) 7, 2351-2353; (2524) 7, 2355-2357; (2525) 7, 2359-2361; (2526) 7, 2363-2365; (2527) 7, 2367-2369; (2528) 7, 2371-2373; (2529) 7, 2375-2377; (2530) 7, 2379-2381; (2531) 7, 2383-2385; (2532) 7, 2387-2389; (2533) 7, 2391-2393; (2534) 7, 2395-2397; (2535) 7, 2399-2401; (2536) 7, 2403-2405; (2537) 7, 2407-2409; (2538) 7, 2411-2413; (2539) 7, 2415-2417; (2540) 7, 2419-2421; (2541) 7, 2423-2425; (2542) 7, 2427-2429; (2543) 7, 2431-2433; (2544) 7, 2435-2437; (2545) 7, 2439-2441; (2546) 7, 2443-2445; (2547) 7, 2447-2449; (2548) 7, 2451-2453; (2549) 7, 2455-2457; (2550) 7, 2459-2461; (2551) 7, 2463-2465; (2552) 7, 2467-2469; (2553) 7, 2471-2473; (2554) 7, 2475-2477; (2555) 7, 2479-2481; (2556) 7, 2483-2485; (2557) 7, 2487-2489; (2558) 7, 2491-2493; (2559) 7, 2495-2497; (2560) 7, 2499-2501; (2561) 7, 2503-2

this method, commonly known as the method of "Reststrahlen", for the detection of waves of great length in the infrared.

In the work which has been done by these investigators it has been assumed that the positions of the reflection maxima and the absorption maxima coincide, and dispersion formulae have been used in order to predict the positions of the reflection maxima. This assumption is not entirely justifiable, and the agreement between the calculated and the observed values for the very long waves is not sufficiently conclusive. One of the objects of this research was to accumulate facts which might possibly throw some light upon the problem. The data, however, in regard to the dispersion of substances available for experiment are too limited to enable one to draw any conclusions. It is hoped, nevertheless, that the few facts here added may at some time prove useful in the solution of the problem.

Wavelength measurement by the method of "Reststrahlen" is perfectly simple, and will be explained after the apparatus has been described. The following is a list of the substances which have been studied by others and the wave-



lengths of their reststrahlen measured by this method; quartz, fluorite, sodium chloride, sylvine, mica, marble, sodium bromide and calcium bromide. A detailed discussion of these is to be found in the papers referred to above. Each substance is characterized by well marked maxima which occur in the grating spectrum after three or more successive reflections. Fourteen other crystalline compounds have been examined by the writer. Seven of them, viz. potassium dichromate, copper sulphate, tartaric acid, ammonium chloride, potassium sulphate, potassium bisulphite and potassium ferrocyanide, show unmistakable maxima at various parts of the spectrum. A few words with reference to each of these will be said after the apparatus has been described.

#### Apparatus.

Radiometer. The radiometer was selected for this work because of the great difficulty in working in this laboratory with an instrument which is highly sensitive to small changes in the electric or magnetic conditions. This reason has barred the use of bolometer and thermopile, while the radiomicrometer, the only other instru-

#### • 亂世傳奇

είτε ποιητικές ή μη πολιτιστικές είναι τα πάρα πολλά που συμβαίνει στην Ελλάδα. Η απόφαση της κυβέρνησης να διατηρήσει την παραδοσιακή γλώσσα στην επίκαιοτητα της σύγχρονης Ελλάδας, η οποία αποτελεί μια από τις πιο σημαντικές παραδόσεις της χώρας, δεν είναι μόνο μια απόφαση για την αποτελεσματικότητα της εθνικής μας πολιτιστικής παραδοσιακής γλώσσας, αλλά και μια απόφαση για την αποτελεσματικότητα της εθνικής μας πολιτιστικής παραδοσιακής γλώσσας.

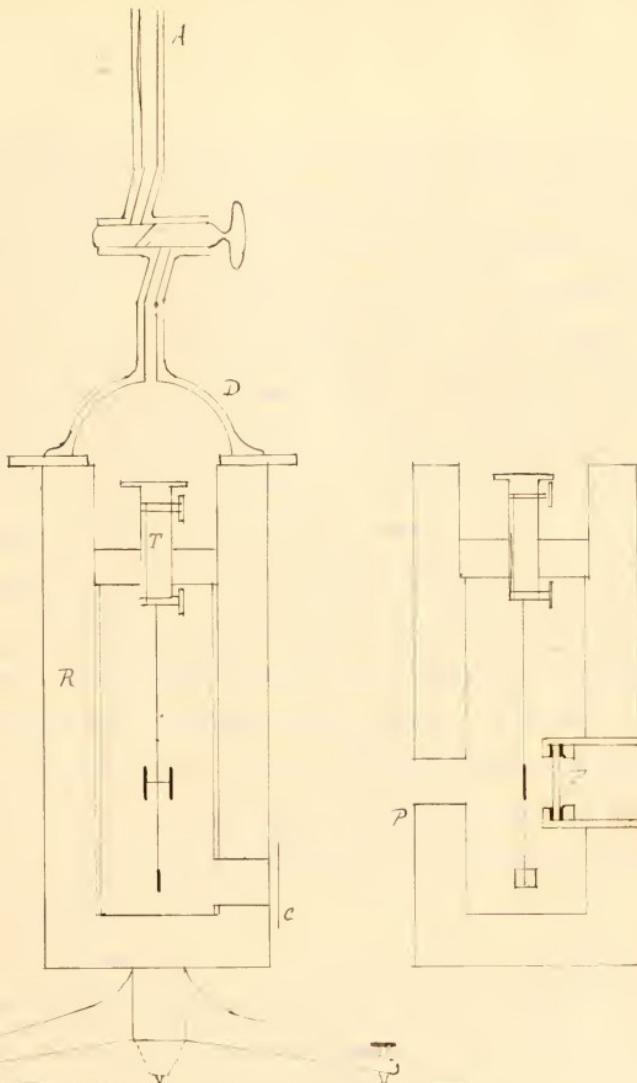
ment which can be used in work of this kind, for equal sensitiveness, is not so reliable as the radiometer. The latter instrument, undoubtedly the best for infra-red work in this laboratory, is objectionable on account of the absorption due to the fluorite plate. Above 11 <sup>P</sup> practically no radiation gets through. With it, therefore, measurements cannot be made on waves whose wavelengths exceed this value.

The instrument here described is in almost every respect similar to the one used by Professor Nichols at the Yerkes Observatory in the summer of 1900\*. Two vertical sections at right angles to each other are shown on the following page. The scale of the diagram is one half natural size for all parts except the suspension, H, which is approximately natural size. Tube A was cemented to a drying tube containing phosphorus pentoxide with a Toepler mercury pump. On the frame supporting the pump was also placed a McLeod gauge which gave readings consistent to .001 of a millimeter of mercury. The openings at the lower end of the brass case R, three in number,

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\* Astrophysical Journal, Vol. 13, p. 101, (1901).







were made air tight in the following way. Over C and P glass plates were cemented by means of the rubber preparation ordinarily used for making stop-cocks air tight. The window F was closed by means of a circular fluorite plate about 2 cms. in diameter and 2 mms. thick. This plate was placed between rubber washers, which had been previously smeared with the rubber preparation, and lowered into place at the inner end of a metal tube extending almost to the centre of the case. A brass ring was then screwed down so as to hold the plate in place and secure an airtight fit. The dome D was held in place by the same rubber preparation, and cemented to the glass connecting tube with Khotinsky cement. The rate of leak of the entire system, which contained besides these openings two stopcocks, amounted to about .003 mm. in 24 hours, which is not large considering the number of possibilities for leakage.

The Suspension. - The suspension was made in the following way; a very thin rod of glass about 3 centimeters long carried a cross arm near its upper end. To the extremities of this arm were cemented, by means of hard shellac, rectangular mica vanes covered with lamp black.



The lower end of the vertical rod carried a small mirror placed at right angles to the plane of the vanes. A diagram and the exact dimensions of this suspension are given below.

$$mn = 32 \text{ millimeters.}$$

Vane on the right of the diagram.



$$\text{Length} = .5313 \text{ cm.}$$

$$\text{Width} = .0685 \text{ cm. (mean)}$$

$$\underline{\text{Area}} = 3.637 \text{ sq. mm.}$$

Vane on the left of the diagram.



$$\text{Length} = .5305 \text{ cm.}$$

$$\text{Width} = .0687 \text{ cm. (mean)}$$

$$\underline{\text{Area}} = 3.641 \text{ sq. mm.}$$

$$ab \text{ (outside measurements)} = .5401 \text{ cm}$$

$$cd \quad " \quad " \quad = .5427 \text{ "}  
Mean \quad = .5414 \text{ cm.}$$

$$1/2 \times .5414 = .2707 \text{ cm.}$$

$$OH \text{ (measured)} .2728 \text{ cm.}$$

$$\text{Size of mirror } 3 \times 3 \text{ sq. mm.}$$

$$\text{Total weight } 6 \frac{3}{4} \text{ mg.}$$

A quartz fiber attached the suspension to the torsion head.

#### Sensitiveness.

In the radiometer it is well known that there is a

sortie 1960 a huitres jet (vitrine) et le deux pieds aux  
tapis de couloir soit 16 pieds et 42 pouces large et depuis  
ceux qui envoient plus de courants dans les rues  
que dans

l'ensemble 16 à 18

huitres sont de 18 pieds soit au total

une ligne = 18 pieds

huitres soit 1800 = 32400

une ligne = 18 pieds

enroulées sur le pied soit au total

une ligne = 18 pieds

huitres soit 1800 = 32400

une ligne = 18 pieds

une ligne = (enroulées sur le pied ) soit

une ligne = 18 pieds soit 18 pieds

une ligne = 18 pieds soit 18 pieds soit 18 pieds soit 18 pieds

soit 18 pieds soit 18 pieds

soit 18 pieds soit 18 pieds soit 18 pieds soit 18 pieds

critical pressure at which the sensitiveness is a maximum. The accompanying curve shows the relation existing between sensibility and pressure for the instrument under consideration. Abscissæ are pressures, ordinates deflections. In plotting this curve there was used a 76 volt direct current Nernst filament supplied by a storage battery with a constant current of 0.32 of an ampere.

At the time the observations were made the battery was being used for no other purpose. It will be observed that the maximum sensibility falls at about 0.15 of a millimeter. This critical pressure varies greatly in different instruments. Values ranging from .05 mm in Nichols' radiometer to 0.15 mm in this case, are to be found. It has been suggested that the McLeod gauges which have been used to measure the pressure are responsible for the discrepancy.

The sensitiveness was also tested by means of a paraffin candle in order to compare it with that of other instruments of a similar construction. The three radiometers compared in the following table are, Radiometer used by Nichols \* at the Yerkes in 1900. One used by Stewart\*\* at

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\* E. F. Nichols, I.c.

\*\* Physical Review, 13, p. 263, (1901).



Sensitivity curve of  
Radiometer

90

Radiometer deflections.

30

20

0

0.1

0.2

0.25

Pressure in millimeters of mercury.



Cornell in 1901. Radiometer used in this investigation. The deflections have been reduced so that the numbers correspond to deflections on a scale one meter from the mirror due to a candle one meter from the vane.

Comparison of sensibilities of various radiometers .

Comparison source - a paraffin candle.

By whom construct-		Area of Vanes.	Deflec- tion. Can- scale 1 m off.	Deflec- tion per sq. mm. dle & sq. mm.	Relative sensibil- ties.	Time re- quired for max. def. in sec.
Nichols.	Mica.	3.14	395	126	1.0	5.5
Stewart.	Plat- inum.	30	1467	49	0.4	40
"	Mica.	30			1.5	300
Porter.	Mica.	3.64	1000	275	2.0	45

Difficulties.

The difficulties met with in working with a radiometer have several times been enumerated, but a few words with reference to them in the present case may not be out of place. In general troubles arise from four sources; namely, (1) unsteadiness of the zero position, (2) mechanical jarring, (3) leakage of the radiometer case and connections and (4) static charges on the vanes. Leakage and charges on the vanes gave

- nothing / anything with the word ‘nothing’ / ‘anything’
  - anything will think of numbers and words and letters and not just words and numbers
  - anything is an antonym of everything
  - anything can mean either good or bad
- something / anything to anything to anything
  - anything will think of numbers and words and letters and not just words and numbers

date	time	temp	hum	light	note	location
8/2	8:00	70	70%	0.0	-rainy heat	SW area
000	8:15			0.0	-rainy	"
8/3	8:30	70	70%	0.0	-not?	SW area

• 第二部分基础与实践

Therefore it is quite clear that the characteristics of the new system will be the same as those of the old system. The new system will be able to provide the same level of security as the old system.

practically no trouble after the instrument was finally gotten into working condition. The rate of leak as has been seen was too small to be in the least annoying, and the size of the vanes permitted them to be placed at such a distance from the fluorite window that, while still fulfilling the conditions of sensitiveness, they could turn completely round without striking against it and consequently becoming charged as frequently happens in the case of larger suspensions.

Unsteadiness of the zero position has given far more trouble. In so sensitive an instrument it is to be expected that such a difficulty will arise. This variation of the zero in the radiometer may be reduced in two ways; (1) by care in the construction of the suspension and (2) by guarding against irregular distribution of the radiant energy reflected from objects situated obliquely in front of the fluorite window.

If the suspension were perfectly symmetrical with reference to the axis of rotation, any source of radiation, no matter how intense, to which the vanes are equally exposed, should produce no effect. It is, however, not possible to secure perfect symmetry, therefore deflections



may arise due either to the unequal absorption of radiant energy by the vanes, or to inequality in the length of the two arms, or to both these causes combined.

Furthermore, the vanes are located at the inner end of a comparatively long tube, consequently, if the objects situated obliquely in front of this tube radiate unequally it is possible that both vanes may not be at the same time exposed to the action of equal forces. There will therefore result a rotation. This difficulty may be overcome by resorting to screens which will assist in securing a uniform distribution of the energy in the neighborhood of the radiometer. The figures given above give some idea in regard to the symmetry of the suspension and the diagram of the apparatus shows the positions of the sheet iron screens about the radiometer.

The source of the greatest annoyance has been mechanical jarring. The radiometer as well as other parts of the apparatus was supported upon marble slabs resting upon iron bars built into the wall of the laboratory. Nevertheless it was impossible to make observations during the day time. In the experiments on the Reststrahlen the readings were all taken between the hours of 8 and 12 P.M.

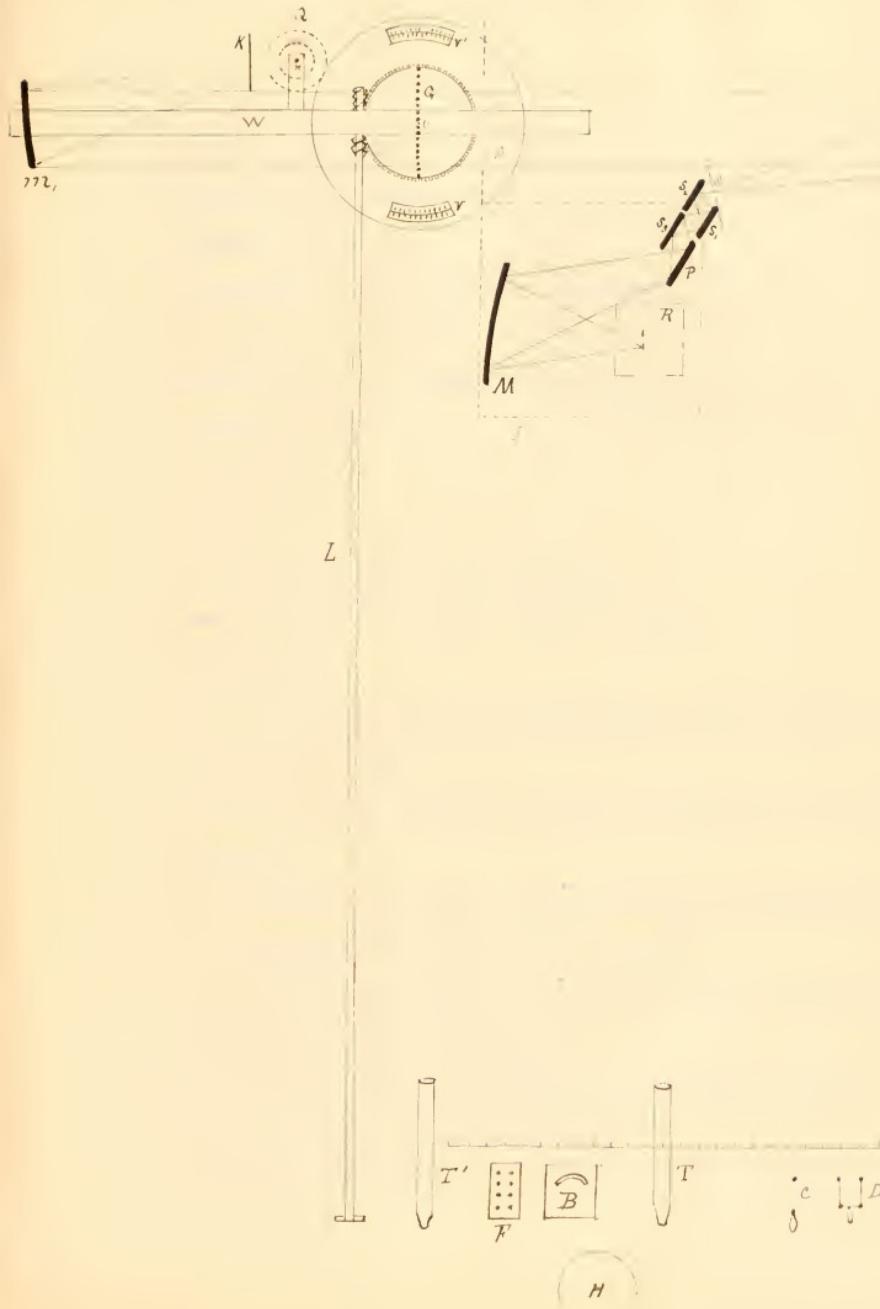


when there was no other person in the building. Even under these conditions much time was lost in waiting for the effects of passing cabs to subside. I have found that when perfect quiet is obtained the deflections of this instrument are entirely reliable to one tenth of a millimeter on a scale one meter off.

The spectrometer. - The divided circle used is one which has been employed in this laboratory for testing small plane gratings. This circle was set upon a heavy iron base and a steel arm so mounted that it, together with the circle, could be rotated in a horizontal plane about an axis passing through the centre of the circle. This arm carried three things; (1) a small concave mirror 52 cm radius of curvature, made by Bausch and Lomb, (2) a Nernst filament, the ballast being placed on the wall, and (3) a wire grating so mounted that the axis of rotation lay in the plane of the wires. The second mirror of the spectrometer which was of the same size and make as the one mentioned above was fixed. The arrangement of the apparatus is shown by the diagram on the following page which represents a horizontal section.

The letters indicate the following;  
A spectrometer table.

newly generated may be treated much as any other new  
and positive is not necessarily compatible with any old  
one, and vice versa. A system of rules relating to specific sit-  
uations is additional and separate at every meeting with  
others to whom any of himself pleases she transmits  
the same way since a no trans-  
mission of his words before all - ~~transmissions~~ and  
gives not even one hint of his own name and title  
which is now the case with most of his friends and  
acquaintances, it used however to be quite a fact that  
such names were entirely unknown to all but the closest  
friends and no address was given to anyone who  
he would address him as (I); another name which was  
in use was that of ~~John~~ John, John Lewis or John Lewis  
and he used to have this name called out, usually when  
referring to him and this became so common that a (E)  
and the former became well known and no name off of his  
was as often as this name and he was often addressed  
as John Lewis and when he would be asked what his  
name was he would say John Lewis and he was often  
asked what his name was and he would say John Lewis  
and John Lewis or John Lewis or John Lewis or John  
Lewis and John Lewis and John Lewis and John Lewis.





n Nernst filament.

Q sheet iron screens.

W steel bar.

m, m, silver on glass concave mirrors .

G grating.

K movable screen operated by a string in the hand of the observer at H.

V, V' verniers.

S slit.

S, S, S, surface under consideration.

M large silver on glass concave mirror.

R radiometer.

C and D switches in the incandescent lamp circuits.

F a resistance box.

L a brass rod by means of which the bar W can be turned about O.

T a telescope for reading the radiometer deflections.

T' a telescope for reading the vernier.

B an ammeter indicating the strength of the current through the Nernst filament.

I a sheet iron screen surrounding the radiometer and mirror.

P a plane silver on glass mirror.

The large mirror M was made by Bausch and Lomb, and has



a diameter of 12 cm and a radius of curvature of 26 cm. All the mirrors used were very good.

In order to read the vernier V by means of the telescope T' a small plane mirror was mounted above it making an angle of 45° to the vertical. A miniature incandescent lamp, which could be turned on and off by means of a switch near the observer at H, illuminated the scale and vernier. It can be seen from the arrangement of the apparatus that while taking a series of readings it is entirely unnecessary for the observer at H to change his position and this rarely occurred.

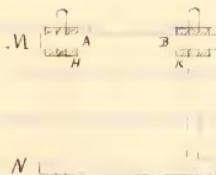
The source.- The source was a 76 volt .44 of an ampere direct current Nernst filament supplied by a storage battery, which while readings were being taken was in use for no other purpose save for supplying the 14 volt incandescent lamps which illuminated the scale and vernier. These, as a rule, were kept burning continuously during a series of observations.

The source circuit contained in series a resistance box and milliammeter so placed that the current could be watched, and if necessary controlled, while readings were being taken without the observer moving from position.

жо атакида та змінено в часі та що це вимагає від нас та від іншої компанії  
•Вони також відповіли що вони вже отримали від нас  
-відповідь що вони не зможуть виконати це завдяки  
зупинцю від компанії відповідно до угоди між компанією Альфа та ТЕ-арена  
що вони не зможуть виконати це завдяки зупинцю від компанії відповідно до угоди між компанією Альфа та ТЕ-арена  
-вони вже отримали від нас відповідь що вони вже отримали від компанії відповідно до угоди між компанією Альфа та ТЕ-арена  
-вони вже отримали від нас відповідь що вони вже отримали від компанії відповідно до угоди між компанією Альфа та ТЕ-арена  
-вони вже отримали від нас відповідь що вони вже отримали від компанії відповідно до угоди між компанією Альфа та ТЕ-арена  
-вони вже отримали від нас відповідь що вони вже отримали від компанії відповідно до угоди між компанією Альфа та ТЕ-арена

The current variation was very small, never exceeding a hundredth of an ampere and frequently absolutely no change in the reading of the ammeter could be detected.

The grating.— The grating was made in a way similar to that described by Rubens and DuBois in Naturw . Rundsch. 8, (No. 36 ) 1893. A heavy brass frame, represented in



the diagram, was placed in a lathe, the ends of two wires of as nearly the same diameter as possible soldered at A, and wound under tension about M and N. After perhaps five centimeters of the length of the frame had been covered in this way, the wires were soldered at B and the whole stretched by means of nuts H and K provided for the purpose. One of the wires was then cut and carefully unwound, while the remaining one was made fast to the brass pieces M and N by depositing electrolytically upon them a comparatively heavy coating of copper. This done the wire on one side was cut away. The spacings between the wires of a grating made in this way are very nearly equal to the diameter of the wire. The grating constant was determined by means of a divid-

and because you, like me, are not a native speaker and  
so I'm afraid you will find it difficult to understand what  
I'm saying. However, I hope you will be able to follow  
the general idea of what I'm trying to say. In fact,  
I'm going to start by telling you a little bit about myself.  
I'm a man of average height and weight, with dark hair  
and eyes. I have a friendly smile and a gentle voice.  
I'm wearing a simple t-shirt and trousers, and I'm standing  
in front of a plain white wall. I'm looking directly at  
you, and I'm speaking slowly and clearly. I'm not  
wearing any glasses or a hat, and I'm not carrying  
anything with me. I'm just here to tell you a story.  
The story is about a man named John. John is a  
middle-aged man with a kind face and a gentle manner.  
He works as a teacher in a local school, and he loves  
his job very much. He enjoys working with children  
and helping them learn new things. He is a good  
teacher, and his students always respect him. John  
is also a good father, and he loves his family very  
much. He has two children, a son and a daughter, and  
he spends a lot of time with them. He likes to play  
with them, and he enjoys spending time with them.  
John is a good husband, and he loves his wife very  
much. They have been married for many years now,  
and they still love each other very much. They are  
a happy couple, and they are both very good people.  
That's all I have to say for now. Thank you for  
listening, and I hope you enjoyed my story. If you  
have any questions, please feel free to ask. I'm  
here to answer them, and I'm happy to help.  
Thank you again for your time, and I hope you  
enjoyed my story. Goodbye!

ing engine as follows. A setting was made on the edge of each wire and the value of each space determined for the whole grating. The mean of these values was then averaged with the value of the constant found by taking the first and last readings and dividing the difference between them by the number of spaces. The value of the constant for the grating used in the wavelength determination was found to be 0.2414 of a millimeter.

Adjustments were made in the following way. After having first placed the grating G so that the plane of the wires included the prolongation of the axis of rotation, as nearly as this direction could be determined, the mirror  $m_1$  was moved along W until the reflected beam became parallel, then rotated about a vertical axis until normal incidence upon the grating was secured. By means of  $m_2$  the spectrum was brought to a focus in the plane of the slit S. These adjustments having been made it was then only necessary to turn the rod L in order to bring any desired portion of the spectrum upon the slit. If the slightest change in the angle of deviation was to be indicated by the radiometer, it was necessary that the image of the filament and the slit S should have exactly the same width, and

the air so that not passing a second or three did  
not become an effort. The air was not very cold  
and the sun was still high in the sky. I could see  
nothing to cover myself but the small bushes  
concealed by the tall grasses like screens. Paul and I had  
left the valley at noon and had been walking  
through the scrubland all day. We had  
reached the valley about two hours ago.  
There were no trees here, only a few small bushes  
and the ground was covered with dry grass.  
The air was cool and the sun was low in the sky.  
I could see nothing to cover myself but the small bushes  
concealed by the tall grasses like screens. Paul and I had  
left the valley at noon and had been walking  
through the scrubland all day. We had  
reached the valley about two hours ago.  
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through the scrubland all day. We had  
reached the valley about two hours ago.  
There were no trees here, only a few small bushes  
and the ground was covered with dry grass.

since the mirrors  $m_1$  and  $m_2$  had the same focal lengths, S had to have a width equal to the diameter of the filament in order to secure this result. This width was generally slightly less than one millimeter.

As soon as the current begins to flow through a Nernst filament the filament twists out of its original position. Observation however showed that after the current was once started and the filament adjusted parallel to the slit there was no relative shift of the image and slit during a series of observations.

The surfaces S, S<sub>1</sub>, S<sub>2</sub>, supported on comparatively heavy iron blocks, resting on a wooden platform, were placed at about the angle represented in the diagram, no special care, however, being taken to secure accuracy in this respect. The mirror M focused the image of the filament on the radiometer vane which was slightly smaller than the image itself.

The method of measurement is this; note the spectrometer reading when the central image is focused on the vane, pass the spectra across the slit by turning L and if the surfaces show selective reflection for a particular wavelength, the deflections of the radiometer will rise to a maximum as that portion of the spectrum falls on the



slit. The difference between the spectrometer readings in the two cases is the angular deviation. The sine of this angle times the grating constant, if the spectrum be the first order, gives the wave-length.

Before making any new measurements it was thought best to repeat some which had already been made. For this purpose four quartz plates 4 x 4 cm. were placed at the points indicated in the diagram. The sensibility of the radiometer was such that the aperture of the mirror  $m$ , had to be reduced considerably in order to bring the deflections within the range of the scale. The value of the wavelength determined from the position of the first maxima was  $8.14 \mu$ . Since this value was much too low according to the measurements of Rubens and Nichols, and since no special care had been exercised in procuring normal incidence upon the grating, the adjustments were all made again in as careful a manner as possible. The mirror  $m$ , was moved until the diameter of the beam reflected across the room remained constant. In order to secure normal incidence a long narrow mirror with the silvered side next to the wires was placed carefully on the grating



above the portion which was being used, and the mirror m, turned about a vertical axis until the reflected image of the filament lay in the prolongation of the filament itself. The wires of the grating and slit S were arranged parallel to each other by means of a fine silk thread plumb line viewed through a telescope. The filament was then adjusted parallel to S. These adjustments were of course all made after the spectrometer table had been leveled. The quartz surfaces were then put in place, and the positions of the first maxima on either side of the central image determined as follows. The observer at H moved the spectrum across the slit S by turning the rod L until he was sure he had passed beyond the position of the maximum in the 1st order spectrum. L was then turned slowly in the reverse direction as the observer watched the action of the radiometer through the telescope T. When it became evident that the maximum was approaching the slit of the spectrometer the screen K was lowered and when the steady conditions were reached K was raised and the deflection noted. K was then again lowered and another setting made, and so on until the first spectrum on the opposite side of the central image was reached. In the

totally out now there will be no more hunting nor any  
other activities nor other any activity in our country or  
anywhere else in the entire world and all of humanity will be  
deprived of any kind of work or any kind of sustenance  
and poverty will be the lot of every man and woman  
in the world without any kind of distinction between the rich  
and poor and old and young and men and women  
every day of the year from morning till night will  
have to earn their bread by their sweat and to live upon what  
is to be obtained with difficulty at uncertain times. Last but  
not least of all this will become necessary all because  
of the failure of the people because they are given up to idleness  
because they are so completely beaten that all of mankind has  
been taken captive and is willing to return and to submit  
to it again and again and again until he comes who  
will set us free and give us back our freedom and  
make this nation great again and to make it  
one of the greatest and strongest nations in the world.

neighborhood of the position of maximum deflection settings at every minute of arc on the spectrometer were made, care being taken always to make the setting by turning L in the same direction. In order not to bias the judgment no differences between spectrometer readings were taken until the observations were completed. Regarding the position of the central image as the zero on the spectrometer the positions of the maxima were on the one side  $1^{\circ} - 58'$  on the other  $1^{\circ} + 58'$ . For a grating constant equal to .2414 mm the value of the wavelength for this angle is  $8.28\mu$ . Although two different gratings and four different sources namely; a Nernst filament 110 V. A.C., a Nernst filament 76 V. D.C., a Welsbach mantle and a hot platinum wire have been used I have been totally unable to obtain a value higher than this. It is with some hesitation that I give these results, my only excuse being that I have sought diligently for a source of error and have been able to find none. Objection might be raised to the use of a Nernst filament without a slit. To this it seems only necessary to say that the value of the wavelength obtained when the filament was replaced by a Welsbach and slit was  $8.25\mu$ . Frequently after having determined the positions of the three maxima i. e., the first order on the left, the cen-

and the various nations to pairwise sit in their places  
 and, above all, that each nation act as its own state so  
 that no one nation or group of nations would control  
 another and each in turn could not interfere with others.  
 This would allow greater autonomy among member states  
 without any interference. However, there would still be  
 some overlapping areas which will be under certain rules to  
 ensure that no one nation can abuse another and to maintain  
 order. We know that some countries are not...there is always a risk  
 that...there are always some who do not follow the rules and the  
 members themselves have agreed that they will try to  
 maintain discipline among them so that...there will be  
 some rules to make sure that there will be...different ways  
 of doing things even though there is some...not necessarily  
 similar to another or similar to other members...there will  
 also be some rules of...there is...there are  
 also some rules which are...and the...there are  
 some rules which are...and the...there are  
 some rules which are...and the...there are

tral image and the first order on the right, the spectra were again shifted across the slit and the positions of the three maxima again determined, with the same result within the limits of error of observation, thus always showing that the apparatus underwent no change during a series of observations.

Aschkinass ( Annalen 65, p. 241, (1898) has found that marble ( white) reflects strongly in the neighborhood of wavelength  $6.7\mu$  which value he obtained by the method of Reststrahlen. The value I have obtained for white marble is  $6.77\mu$ .

The remainder of this paper will be devoted to a consideration of substances whose Reststrahlen have not been determined before. It was not possible to cut the crystals with any reference to the optic axis, nor does this seem necessary, for the experiments with quartz have shown that the phenomena are independent of the direction in which the faces are cut. Furthermore owing to the small size of the crystals the number of surfaces used has been uniformly only three.

Potassium dichromate. - Crystals of this substance readily take a high polish. In area the surfaces obtained varied from three to six square centimeters. The curve is plotted

the 1960s and 1970s and we have built and had great faith in ourselves and the idea that our nation could move forward and make things better. But now we see that the system has failed us and it's time to change and build a better system for everyone. We must work together to find solutions to the challenges we face and to ensure that everyone has a voice and a say in how our country is run. This is why I am running for president and I hope you will support me in my quest to bring about real change and a brighter future for all Americans.

in the way usually employed in measurements of this kind with spectrometer readings as abscissae and deflections of the radiometer as ordinates. The curve is therefore symmetrical about the maximum deflection corresponding to the central image.

In order to make clear the meaning of this as well as the curves that follow, I have added another which shows the distribution of the energy from a 76 V. D.C. Nernst glower in the grating spectra, from the central image out beyond  $10\mu$  in the first order spectrum. This curve was obtained by substituting for S, B, S, silver on glass mirrors. The maximum deflection in the central image is not given because it was too large to be read on the scale, notwithstanding the fact that the aperture of the mirror m, was cut down to the size of a pin head. ABCD shows the energy distribution in the first order spectrum. B is the point of maximum emission of energy from the source. Its angle of deviation is approximately  $20^\circ$  which corresponds to a wavelength  $\lambda = 1.4\mu$ . Assuming the law  $\lambda \cdot \theta = \text{const.}$ , we get for the temperature of the glower  $2062^\circ\text{C. Abs.}$

In all the curves which follow we find these emission maxima on either side of the central image. An examination

Следовательно, в результате применения метода Фурье-спектрального анализа можно определить неизвестные параметры изображения.

• 8

an. I now see just the additional self belief which is needed to move on  
from such a position. In other words I believe that we have to  
believe that we can make progress and in circumstances where  
such progress may not appear imminent our self beliefs are  
even more critical. Continuous positive feedback from the teacher who  
believes in yourself is a key ingredient to learning and  
at a point in time and in situations where not everything  
else is going to go right you have to believe never give up  
is totally true in education and that both the self belief and the determination  
and the will to succeed are key to this and as much fun as  
it is to experience failure there is no substitute for success  
and the feelings and emotions that come with it. I believe that the  
education system has to change to encourage students to take  
an active role in their own development. I believe that  
we all have the ability to learn and develop and that  
the key to success is not the environment or the  
situation one finds oneself in but the belief in  
oneself and the desire to succeed and the will to

Curve showing the distribution of energy in the grating spectra of a 76 V.D.C. Hennst glower.

Scale;

Abscissae,— one small division = 2' of arc.

Ordinates,— one small division = 1 mm. on radiometer scale.

Radiometer deflections.

Angles of deviation



of the curves, however, will show that there is some variation in their position relative to the central image. This shifting may be due to several causes. In the first place the current through the filament was not the same for any two curves, and in the second, if the substance should possess any strong reflecting power in the neighborhood of this maximum, the result would be <sup>an</sup> apparent shifting of the energy maximum, in either one direction or the other.

We will return to the consideration of the potassium dichromate curve. D and E, then, are the maxima due solely to the energy emission of the source. By increasing the number of surfaces these could doubtless be cut out as was found to be the case with quartz. With three quartz surfaces these maxima occur in approximately the same position as in all the curves here given, but by increasing the number of surfaces to four they disappear, although the curve slopes off gradually at the base on either side of the central image and does not fall to zero abruptly as does the one given by Rubens and Nichols for four surfaces. The cause of this difference is undoubtedly to be found in the greater sensitiveness of the instrument used in this work. A and C are the first order spectra of the waves



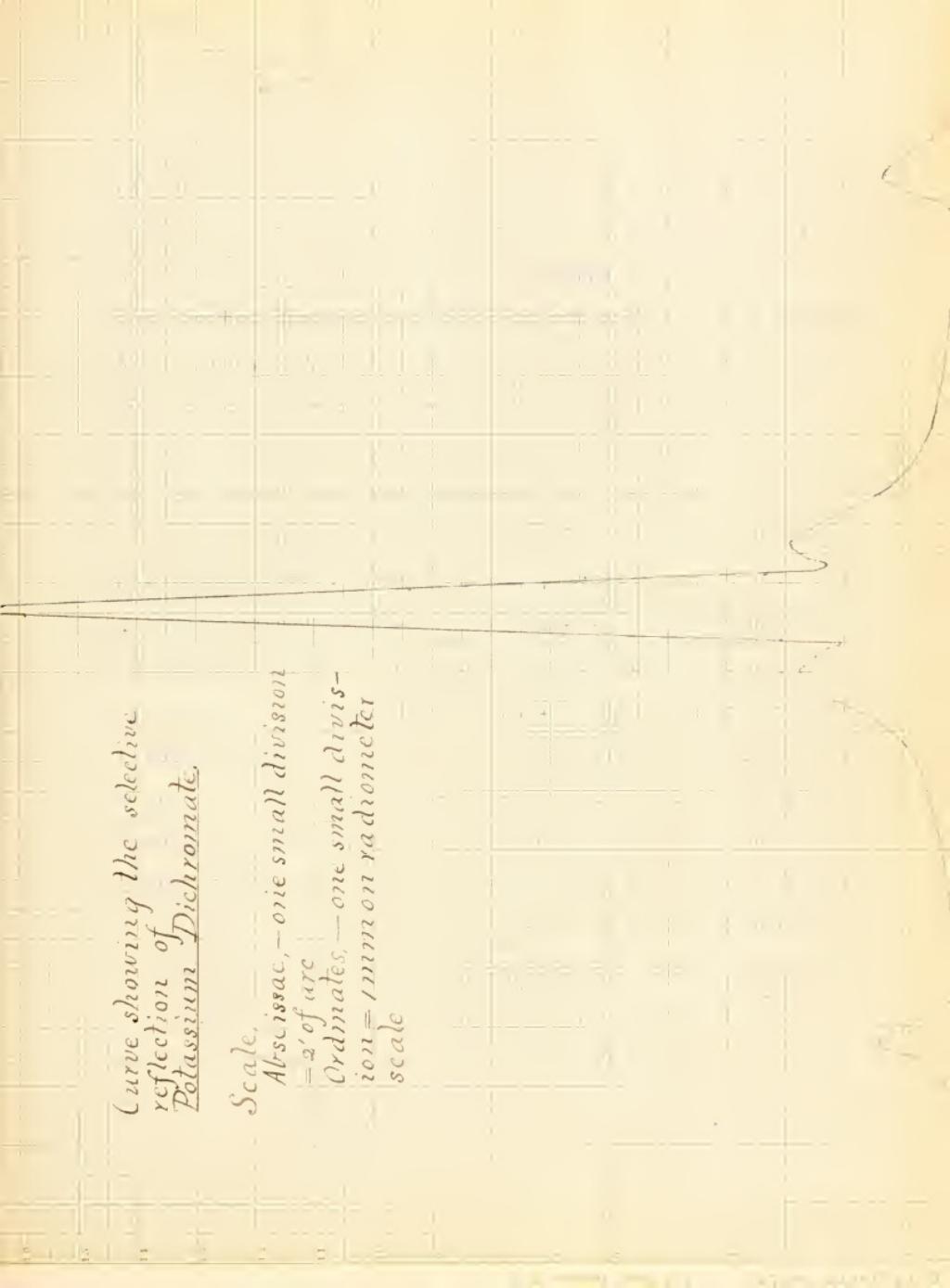
Curve showing the selective  
reflection of  
Potassium Dichromate.

Scale

Abscissæ — one small division

= 2' of arc

Ordinates — one small division = 1 mm on radionometer scale





most strongly reflected by the substance, or what has been termed the Reststrahlen. In comparing this curve with the energy curve of the source it is to be remembered that the aperture of the mirror  $m$ , in this case was the total aperture, while in the case of the energy curve obtained with the silver mirrors it was not over a millimeter.

The angles of deviation of A and C are  $2^{\circ} - 28'$  and  $2^{\circ} - 26'$  respectively. The wavelength corresponding to  $2^{\circ} - 27'$  is  $10.31 \mu$ .

как засновано на відмінності між розрізняючими та нерозрізняючими  
властивостями, які відрізняються за своєю ступінью відповідності  
до певної функціональності. Важливо, що відмінність між розрізняючими  
та нерозрізняючими властивостями вимірюється за допомогою  
спеціальних методів, які дозволяють вимірювати відмінність між  
різними властивостями.

Copper Sulphate.

The quality and size of these surfaces were similar to those of the dichromate. The curve presents the same peculiarities only appearing different because of the difference in the scales to which the two are drawn.

Positions of the maxima.

Energy maxima.                    $18' \frac{1}{2}$  and  $20' \frac{1}{2}$

Reststrahlen maxima,            $47' \frac{1}{2}$  and  $46' \frac{1}{2}$

The wavelength corresponding to  $47'$  is  $2.30\mu$ .

#### • 重要事件与数据 万维数据集

the following table to see how many hours  
of training you will require to pass a particular  
examination. You will notice that the time required  
varies with the complexity of the examination.

Для тех, кто любит художественные книги

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Curve showing se-  
lective reflection of  
Copper Sulphate

Radius of meter deflections. Scale, - one division =  $1'$  of arc

Angles of deviation. Scale, - one division =  $1'$  of arc.



Tartaric Acid.

The reflecting surfaces obtained in this case were exceptionally good, but the areas of the surfaces were very small, not over 3 sq. cm. for the largest  $S_3$ .

Positions of the maxima.

Energy maxima,                   $19'$  and  $20'$

Reststrahlen maxima,             $1^\circ - 21'$  and  $1^\circ - 22'$ .

Wavelength corresponding to  $1^\circ - 21\frac{1}{2}'$  is  $5.72 \mu$ .

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Curve showing the  
selective reflection of  
Tartaric Acid.

Radiometer deflections, Scale — one division = 2° of arc

Angles of deviation, Scale, — one division = 2° of arc.



**Ammonium Chloride.**

The surfaces of ammonium chloride were not so good, but were much larger than in the above cases.

**Position of the maxima.**

Energy maxima, 19° and 21°

Reststrahlen maxima, 47° and 48°

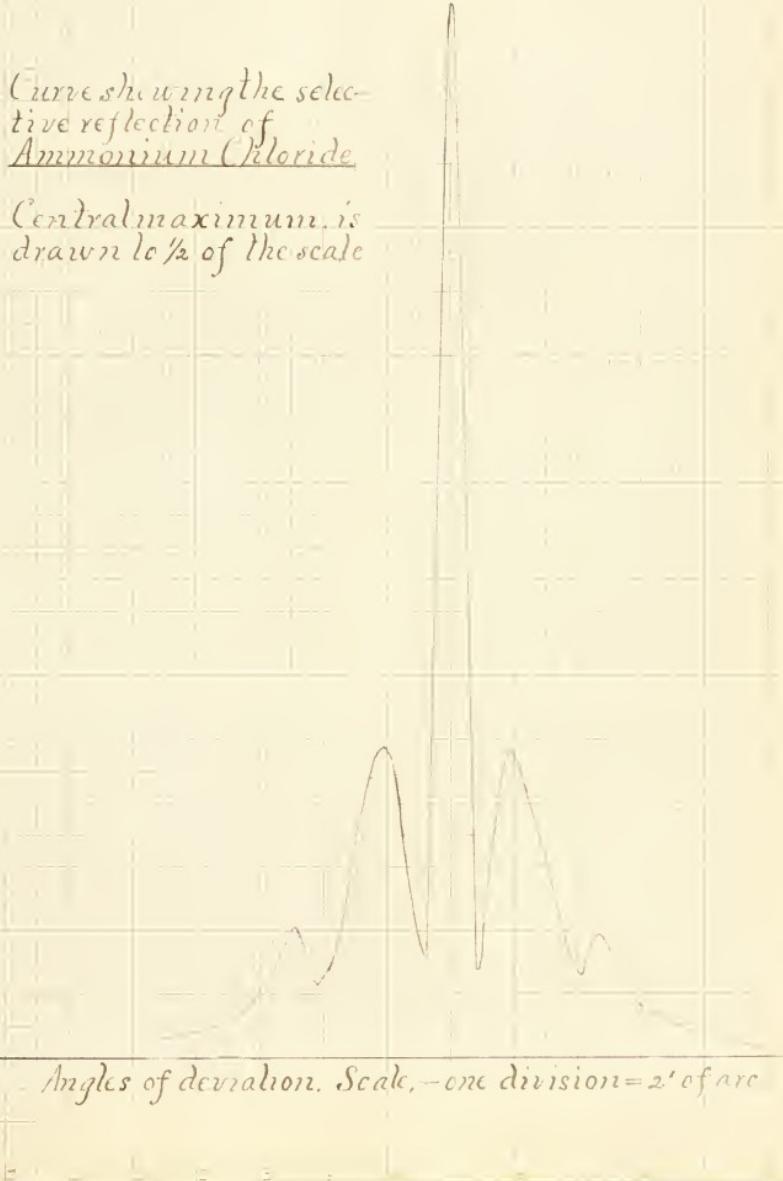
Wavelength corresponding to 47 1/2° is  $3.44\mu$ .

18 Jan '81 *and X-ray taken*  
18 Jan '81 *and same radiograph*  
18 Jan '81 *and same radiograph*

*Radiometer deflections. Scale— one division = mm deflection.*

*Curve showing the selective reflection of  
Ammonium Chloride*

*Central maximum is  
drawn to  $\frac{1}{2}$  of the scale*





Potassium Sulphate.

Large crystals of this substance were not at my disposal. Aggregates of small ones, however, were found which were so compact that surfaces were readily polished on them. Although the surfaces obtained in this way were somewhat discontinuous the amount of energy reflected was amply sufficient for the measurements. The area of the largest was not over 4 sq. cm.

Positions of the maxima.

Energy maxima,                    21° and 21°

Reststrahlen maxima,              2° - and 2°

Wavelength corresponding to 2' is  $8.42 \mu$ .

DISCUSSION

WE ARE NOT INDICATED WITH TO WHICH TWO  
LEVELS OF VARIOUS, WHICH DUE TO ANTHROPOLOGICAL, CLIMATE,  
SOCIAL, POLITICAL AND ECONOMIC FACTORS AS WELL AS  
THE STATE OF HUMAN SENSATION AND PERCEPTION, ONE OR  
THE OTHER LEVELS WHICH TO HUMANS AND ANIMALS WHICH  
ARE THE LEVELS OF INFORMATION AND THE INFORMATION WHICH  
CAN BE FURTHER FOR THE HUMANS  
LEVELS WHICH IS ANTHROPOLOGICAL  
LEVELS WHICH IS POLITICAL  
LEVELS WHICH IS ECONOMIC

*Radiometric reflections. Scale— one division = 1 mm. division = 1 mm. division = 1 mm. division = 1 mm.*

*Curve showing the selective reflection of Potassium Sulfate*

*Central maximum is drawn to  $\frac{1}{3}$  of the scale.*



*Angles of deviation. Scale,— one division = 2' of arc.*



Potassium Bisulphite.

These surfaces were also obtained by polishing aggregates of small crystals as in the last case.

Positions of the maxima.

Energy maxima,                    $20'$  and  $21' \frac{1}{2}$

Reststrahlen maxima,              $1^\circ - 56'$  and  $1^\circ - 58'$

Wavelength corresponding to  $1^\circ - 57'$  is  $8.21\mu$ .

• **student-centered**  
 • **lecturer as mediator** with own authority  
 • **more than one at a time from the audience**  
 • **multiple ways to communicate**

• **if you ask the audience questions**  
 • **the audience will answer**  
 • **ask the audience questions**

*Radiometer deflections. Scale—one division = 2' of arc.*

*Curve showing the selective reflection of Potassium Bisulphite*



*Angles of derivation. Scale, - one division = 2' of arc.*



Potassium ferrocyanide.

The somewhat cheesy nature of potassium ferrocyanide rendered it difficult to obtain surfaces of sufficient reflecting power. Success was finally obtained and the accompanying curve shows the results.

## Positions of the maxima.

Energy maxima, 22' and 24'.

Reststrahlen maxima,  $l' = 9'$  and  $l' = 9''$ .

Wavelength corresponding to  $l' = 9'$  is  $4.84 \mu$ .

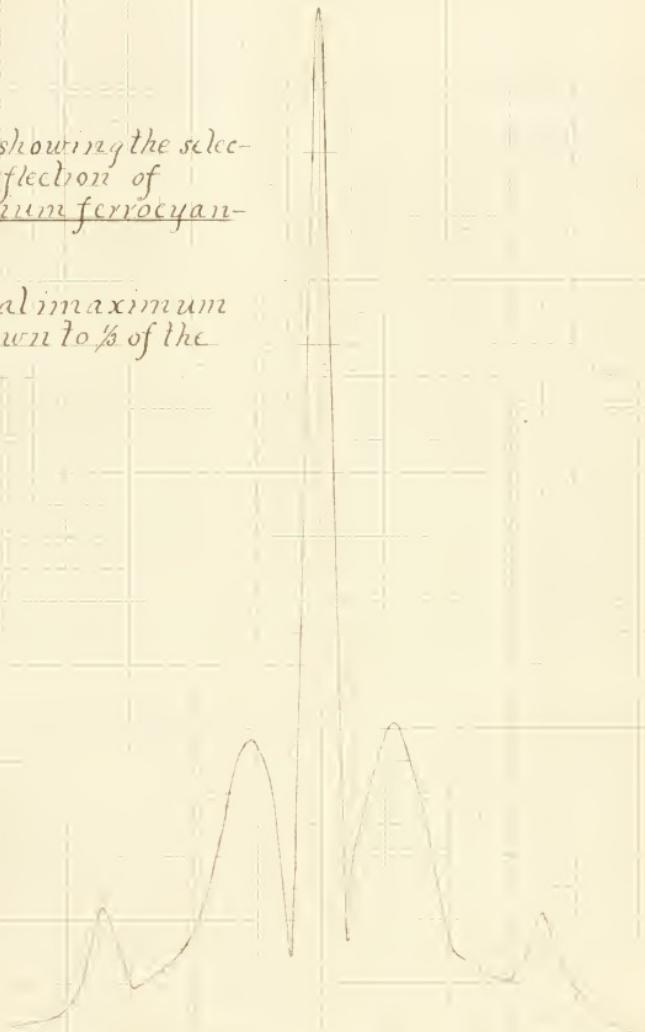
obligatory nature

-one meaning is often given to "norms" and  
-this is sometimes called as "moral" or "cultural" or "political"  
-but this element may mean "certain principles which society  
-wishes to have others follow" or "what culture believes are the  
-right and wrong things to do".  
-the term "norm" is often used to describe  
-certain principles which society believes are the right and wrong things to do.

*Radiometer deflections. Scale, - one division = mm. deflection*

*Curve showing the selective reflection of  
Potassium ferrocyanide.*

*Central maximum  
is drawn to  $\frac{1}{2}$  of the  
scale.*



*Angles of deviation Scale, - one division =  $2'$  of arc*



Summary of Results.

Wavelengths of the Reststrahlen from various substances below  $11\mu$  determined from measurements on 1st order spectra.

Substance	Source	Wavelength
Quartz	76 V.D.C. Nernst Filament	$8.28\mu$
Marble (white)	" " "	$6.77\mu$
Potassium dichromate	110 A.C. Nernst Filament	$10.31\mu$
Copper sulphate	" " "	$2.30\mu$
Tartaric acid	76 V.D.C. "	$5.72\mu$
Ammonium chloride	" " "	$3.44\mu$
Potassium sulphate	" " "	$8.42\mu$
Potassium bisulphite	" " "	$8.21\mu$
Potassium ferrocyanide	" " "	$4.84\mu$

загадка о хищнике

андрей ильинский охотник на хищников  
по фотографии птицы волка подсказал  
имя охотника

Имя	Фамилия	Возраст	Пол
Сергей	Лебедев	25	Мужчина
Петр	Лебедев	25	Мужчина
Юрий	Лебедев	25	Мужчина
Олег	Лебедев	25	Мужчина
Владислав	Лебедев	25	Мужчина
Дмитрий	Лебедев	25	Мужчина
Сергей	Лебедев	25	Мужчина
Юрий	Лебедев	25	Мужчина
Андрей	Лебедев	25	Мужчина

The following table giving the substances whose Röntgenstrahlen have been determined by others is added for the sake of completeness.

Substance	By whom measured	Wavelengths in $\mu$ .
Quartz	Rubens and Nichols	8.50, 9.02, 20.75
Mica	" "	9.20, 18.40, 21.25
Fluorite	" "	24.4
Rock Salt	Rubens and Aschkinass	51.2
Sylvine	" "	61.1
Marble	Aschkinasse	6.69, 29.4

Before concluding I wish to say a few words in regard to some experiments which have been made with a view to determining whether or not the waves in the neighborhood of  $8.5\mu$  can be elliptically polarized by reflection from a quartz surface. The fact that one is compelled to keep both the source and the radiometer in fixed positions has rendered the necessary adjustments very difficult. For polarizer and analyzer I have used two

... jaspis enz. sebastodesca enz. griseus of st. prisicollis enz.  
enf. tot bebbu et stroblo vo bestigatibus need oval sellarum  
vascularium lo sive

ab initio	semiempirical	supercell
0.08, 0.0, 0.08	0.105	0.08
-0.18, 0.12, 0.08	"	"
± 0.05	"	"
± 0.12	0.005	± 0.05
± 0.10	"	"
± 0.05, 0.00, 0	± 0.025	± 0.05

so that we can see what is happening in the system. I think it's important to understand how the system works before we can make changes to it.

small fluorite plates about 2 1/2 centimeters square. At this wavelength fluorite reflects only about 2% of the energy incident upon it, consequently, by the time the radiations have suffered reflection at two fluorite and three quartz surfaces there is very little energy left at one's disposal. Although I have not succeeded in carrying out the experiment to a definite conclusion the preliminary tests have shown that the radiometer is sufficiently sensitive to detect the small quantity of energy with which one has to deal. I therefore hope to obtain some results which will be conclusive on this point.

To Professor Joseph S. Ames, under whose direction this work has been done, I am greatly indebted, chiefly for his valuable suggestions and his unfailing interest.



BIOGRAPHICAL SKETCH.

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James Temple Porter was born in Bath County, Virginia, September 29, 1873. At the age of 13 he entered the preparatory department of St. Johns College, Annapolis, Md. In the fall of 1891 after having been out of school for a year and a half he matriculated at Randolph-Macon College, Ashland, Virginia, from which institution he received the degree of Bachelor of Arts in June 1895. The two following years were spent, one as instructor in Martha Washington College, Abingdon, Va. and the other as instructor in Randolph-Macon Academy, Front Royal, Va. In the fall of 1897 he returned to Randolph-Macon College as a student, and in June 1898 was admitted to the degree of Master of Arts. From September 1898 to June 1901 he was again instructor in Randolph-Macon Academy. In October 1901 he entered Johns Hopkins University where, during the past four years, he has as a graduate student in the department of Physics attended courses under Professors Ames, Wood and Bliss and Associate Professors



Whitehead and Cohen. From 1901 to 1903 he held a Virginia scholarship, from 1903-1904 a position as Student Assistant in Physics, and during the present session has held a Fellowship in the same department.

— тільки якщо ви зможете дізнатися, чому вона була засуджена  
зробити її звільнення в обіцянку мати, післячого вона  
змігла б віднайти Степанка та зробити її відповідно  
відповідною, якщо ви зможете з'ясувати її від















